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(56) Documents Cited
GB 2304252 A GB 2271903 A EP 0597396 A1 US 4829339 A

(58) Field of Search
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(54) Animated parallax display

(57) A lenticular display system has a printed image integral with a viewing screen, capable of displaying continuous animation and, or, three dimensional effects.

By a method of directly capturing and interlacing selected frames from a sequence of images from an electronic display monitor, any number of images, whether originally derived from any source such as film, video or computer, may be incorporated into the display. This is to give the effect of continuous two dimensional animation as though viewing a clip from a motion based sequence, or else to give a stereoscopic effect as though viewing a truly dimensional model, or a combination of both effects.

Use of this technique as a proofing system allows the opportunity of testing a wide number of alternative sequences before selecting the final sequences for production purposes. By optionally using emulsion coated lenticular lens sheet, raster or coated holographic optical element, or direct digital output to a prelenticulated film, obviates the need for post lamination of emulsion to viewing screen.

An automatically activated sound chip may be incorporated into the display so as to simulate the sounds relative to that piece of animation.

FIG. 1.

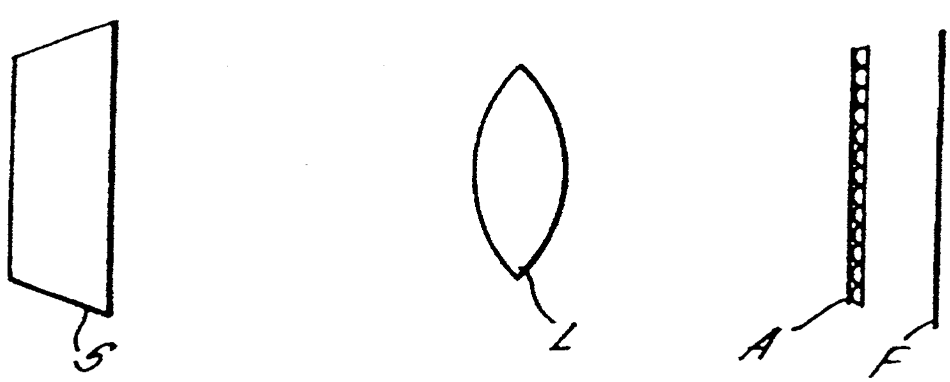

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FIG. 1.

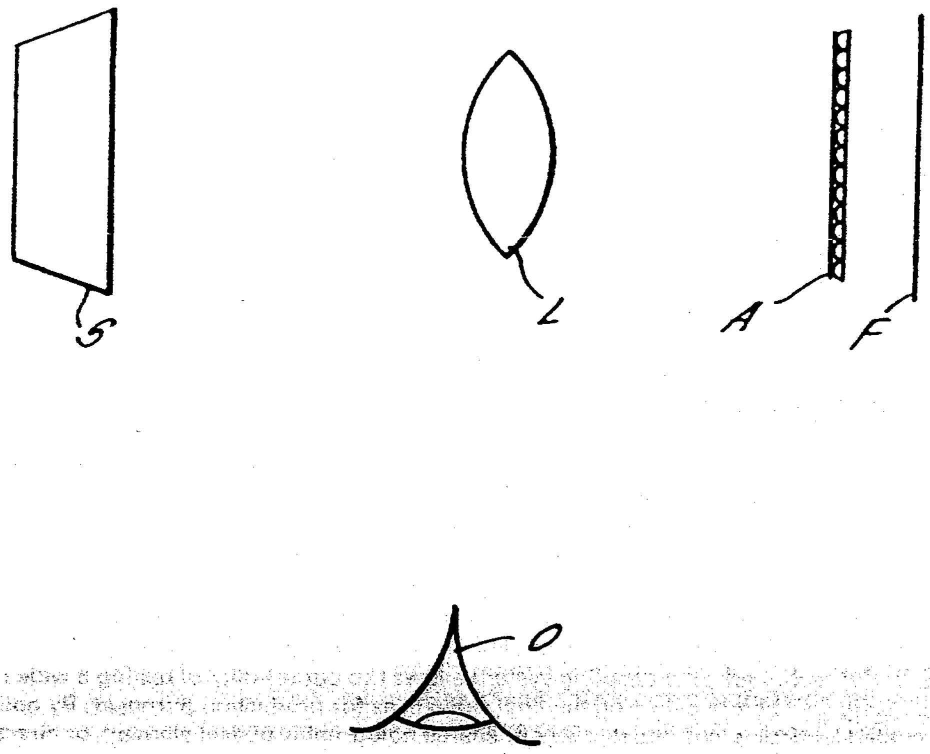


FIG. 2.

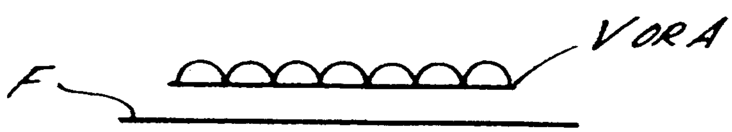


FIG. 3.

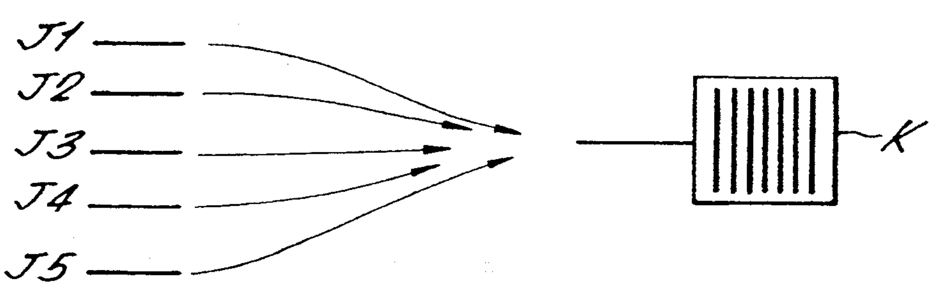


FIG. 4.

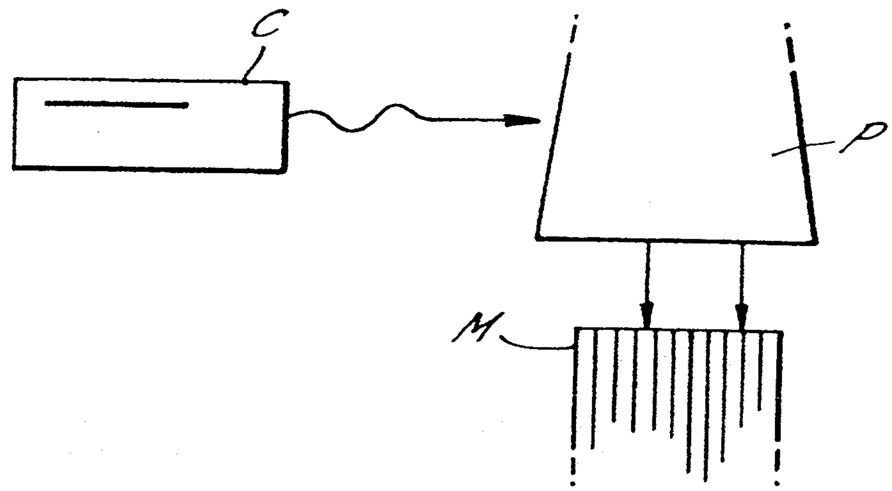


FIG. 5.

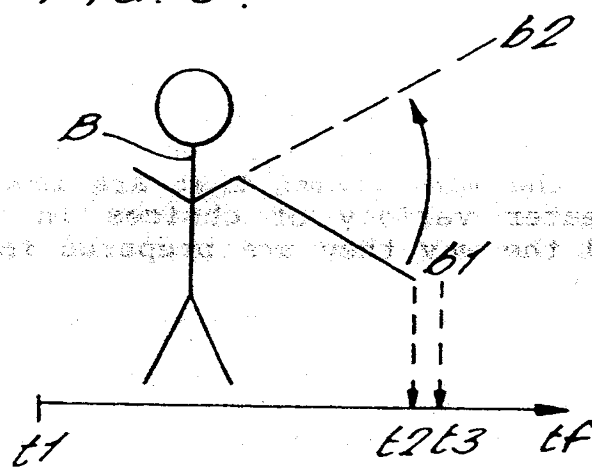
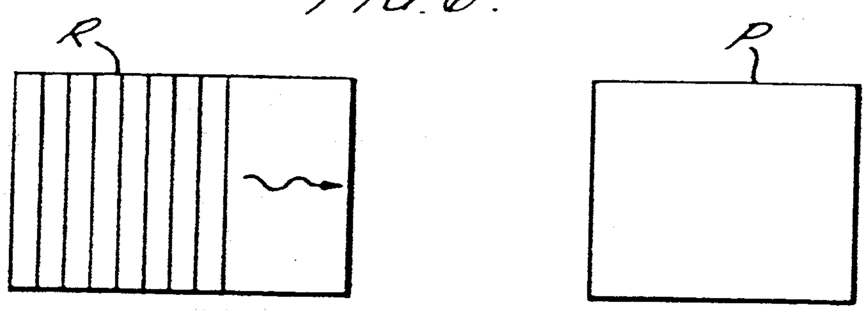


FIG. 6.



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Animated parallax Displays.

This invention relates to animated parallax displays.

Animated parallax displays are well known and include the use of lenticular lens arrays positioned over a printed image which comprise two or more component views.

As the lenticular screen is moved relative to the underlying print, then the different images may become visible to the observer. Dependant on the sequence of the images, and whether the len arrays run horizontally or vertically relative to the observer, the observer will see either a change of image or a series of animations, or a three dimensional effect, or a combination of any of these.

The animations effects are, however, generally crude and jerky, as only a limited number of individual images can be conveniently combined and incorporated into the picture, due to the method by which individual frames are discretely integrated into the final print, and can still be discretely identified on play back. Also, the more frames that are involved, means that there are a greater variety of choices in the selection of those frames and the way they are prepared for combining into the final picture.
Also, the traditional combining systems are opto-mechanical and need actual frames of photographic film as the input medium, and are therefore unable to use video images unless such images are first transferred to film. Such transfers are costly and time taking compared to the direct video interlacing method discussed in this invention.

According to the present invention, there is provided a physical integrating camera, or computer system which simulates the said physical integrating camera, by which any number of individual video or digital images can be incorporated into the interlaced display, directly or indirectly from a video source.
The pysical integrating camera comprises an image display screen (typically a cathode ray tube), an optical relay system (typically a flat field lens), a composite travelling or rotating film assembly comprising an aperture plate (typically barrier grid or lenticular screen) and an image receiving medium (typically film, which may be an emulsion coated lenticular screen or raster), or an electronic suface.
The resulting integrated image is then develop/processed, and viewed through a direction selective viewing screen, referred

to here as a 'lenticular' screen, meaning 'acting as a lens', and which may typically comprise a plastic reeded screen, or a raster grid, or a holographic optical element equivalent.

Alternatively, the physical mask in the physical camera, may be replaced by a computer equivent. In this case, the individual images may be masked by the computer and a composite image made from the merged composite image file. By applying the mask to each frame in turn, prior to interlacing, the file sizes of each saved element is considerably reduced so that the final file size of the combined image is the same size as just one of the component frames.

A sound chip may be incorporated into the final assembly so as to replay programmed sound, such as might be heard during a sequence, when activated by the user.

The traditional method of physically combining individual images has been by a stop/start stacato sequence method. This typically involved exposing the images onto a recording film emulsion, to each image in turn, through a matrix of narrow apertures (typically a lenticular lens or grid). Each image is individally projected, one image after another. Between each exposure, the film holder assembly is moved a finite distance. However, the resulting picture suffers from shortfalls in that only relatively few images can be combined because there is a practical physical limit as to how narrow the apertures can be consistently made and accurately repositioned.
Also, the stop/start nature of the film assembly and/or projected images limits the smoothness/continuity of the resulting image, and the transfer of images from video to film invariably gives potential jitter to the resulting combination.
Non sequential methods are inherently succeptible to motion smear, thereby limiting their application to three dimensional and morphing applications, rather than animation.
Also the use of film as the source of supplying the individual frames, whether projected and recorded by stacato or continuous movement of the screen, is prone to give rise to jitter due to the need to rely upon sprocket hole registration. All these practical considerations significantly reduce the theoretical effectiveness of the final effect.

The present invention uses a direct electronic image as input, either as individual digital files, for digital interlacing, or else for opto-mechanical interlacing as each image is displayed upon a screen, such as a cathode ray tube. The system incorporates a continuously moving aperture plate immediately in front of the recording surface, typically an emulsion coated surface on a stable film base or an emulsion backed lenticular or raster screen. Alternatively, the aperture plate may remain static whilst the emulsion coated base is continuously moved. Or the film holder assembly may be rotated.

During the operation of the camera back, the shutter is operated in order to expose the recording medium to the displayed image, typically on a cathode ray screen, or a liquid crystal screen, or any other imaging display surface, during which time the images or sequences are displayed from the electronic imaging source.
The resulting image then appears as a continuous excert from a video, and in perfect registration, rather than with the jumpy effect of a flip book.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawing in which:

Figure 1 shows one integrating camera, comprising the image display screen, the camera optics, the aperture plate, and the recording medium.

Referring to the drawing, the integrating unit comprises a image display monitor or screen S, an optical relay or lens L, a travelling aperture plate A, or rotational film holder, and an image recording medium, typically film, F, or an emulsion backed lenticular or raster lens sheet. In practice, the aperture plate may be static whilst the film itself is moved but this is considered an inferior method. The pitch of the integrating screen is typically between 0.1 and 1 mm. Ideally the monitor should be monochrome and without colour masks which degrade the quality of the final image, the colour being added by repeated exposure through the approriate filters.

In order to make the integrated picture, the individual images are displayed on a video monitor or projection screen S. At the same time, between the first and last frame, the aperture plate moves, the shutter activated, the plate moving a total distance accordingly matching the pitch frequency of the aperture plate, relative to the film emulsion surface, or rotating through the angle of the screen. The film is then processed.

In figure 2, To replay the sequence, a grid screen or 'lenticular' screen V is located in front of the surface of the film emulsion F, and by moving the head of the observer O, or by twisting the display, the sequence may be played back. Alternatively, the screen may be shifted in relation to the surface of the integrated image.
The sequence itself may be manipulated before being recorded so as to include special effects such as morphing, slow motion areas, insertion of titles, or sublimimal frames, or removal of specific intermediary frames in order to minimse motion blur effects or errors. Blank frames may also be inserted to emphasise animation effects. Also, the use of electronic image manipulation allows for 'rotoscope' effects in order to

maintain subject position, and size, within a sequence, thereby improving the animation effects.

According to whether the aperture plate A moves parallel to, or at right angles, to the direction of motion displayed on the imaging monitor, 3-D effects may be also included in the animation, but great care must be taken to ensure that any horizontal motion in the scene is not confused with depth parallax information. If stereoscopic effects are required, then the aperture plate A and the lenticular viewing screen V needs be placed such that the lenticles run parallel rather than at right angles, relative to the direction of image rotation, compared to recording a purely two dimensional animation.

In figure 3, the individual frames J are digitised and then interlaced' K' by computer before being output to film or paper, or colour separations.

Figure 4 shows output direct from the computer C to a digital printer P, upon pre-lenticulated medium M.

In figure 5, the means of initially selecting frames from within a sequence is demonstrated. The use of Key frames is whereby the motion is divided into equal proportions of the action rather than time proportions, enables far more effective results to be achieved. For example, a five second sequence (t1-tf) of a cricket batsman B may show him taking three seconds to step backwards, ½ second hitting the ball, from position b1 yto b2, in time t1-t2, and one and ½ seconds stepping forwards afterwards afterwards. In other words, the most interesting part represents only 10 % of the total action.

Traditional interleaving methods would combine all frames, in which every frame had equal importance, with the effect that the interesting section would be nothing more than a quick smear. However, by the method hereby disclosed, we have the ability to select individual frames weighted according to the areas of action. In this example, some 80% of the frames wherein in the batsman was not hitting the ball would be omitted from being interlaced, so that the moment of action represents a far greater part of the final sequence.
In other words, we would effectively slow down/stretch out the moments of action, and relatively shorten the duration of unimportance. The interlacing camera system allows the opportunity for rapidly testing alternative choices of frames to be kept or discarded.

To enhance and increase the amount of information which may be encoded into the final image, the pitch of the screen through which the master is created, and therefore the size of the master image, may be increased by a factor several times greater than that of the final product. The proportion of

picture sizes is exactly in proportion to the relative pitch of the lenses.

To help eliminate the effect of strobing, and screen clash, caused by interference patterns created between the line frequency, typically between the red/blue/green matrix of the monitor, and the pitch of recording screen, and any subsequent printing screens, the camera lens may be traversed during exposure, relative to the film, during exposure.

In figure 6, the physical mask R of a raster screen is replaced by a computer equivalent mask program, P, resulting in a composite image identical in appearance to that created with the mechanical mask.

CLAIMS

1. A 'lenticular' display capable of showing continuous animation and, or, three dimensional effects, derived from individual video or digital frames .

2. A 'lenticular' display in which the motion may be continuous, such that individual frames may be no longer discretely recognisable.

3. A 'lenticular' display in which animation from film, video, or computer graphics may be directly transfered.

4. A 'lenticular' display within which frames which control the speed of replay may be selectively discarded or repeated, or otherwise manipulated, so as to create special effects, such as slow motion, within an otherwise consistent speed sequence.

5. A 'lenticular' display in which a sequence consisting of an unlimited number of frames may be incorporated, limited only by film and 'lenticular' screen resolution.

6. A 'lenticular display' in which the animation may be manipulated to give selectively faster or slower animation, even within the same sequence, and in which frames may be 'rotoscoped' in order to maintain subject position and size between adjacent frames.

7. A lenticular display in which certain frames have been eliminated in order to reduce the effect of motion blur.

8. An animation display system in which at least one segment preferably remains fixed in size and space.

9. An integrating camera comprising a video monitor or projection screen onto which the electronic imaging sequence is displayed to be captured. In a preferred situation, a colour monitor would be replaced with a maskless monochrome monitor, with the colpours being created by multiple exposure through colour filters.

10. An integrating camera in which a grid or lenticular screen , or combination of both, is repositioned relative to the photographic emulsion or other image receiving surface.

11. An integrating camera which will accept sequences in which individual frames may have been discarded or repeated. Or frames may be manipulated so as to give special effects such as soft dissolves, 'in-betweening', morphing, zooming, message frames, and other effects.

12. An integrating camera which may use optionally a screen pitch several times coarser than the final viewing screen in order to compress more detail into the final image when reproduced at a smaller size.

13. A lenticular display containing directly captured video material thereby eliminating potential vertical and horizontal registration errors.

14. A lenticular camera in which the receiving emulsion may be coated onto the reverse side of a lenticular lens sheet or raster, or holographic optical element, so as to give instant 3D and/or animation effects after developing, without lamination.

15. A mask which is internally generated within a computer system and which performs identically to the mechanical mask of the raster screen.

16. Outputting the digitally interlaced image directly onto prelenticulated surface, thereby avoiding the need for subsequent lamination.

17. A sound chip may be incorporated, and activated by the user.

DIAGRAMS

The Patent Office

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Application No: GB 9607800.1
Claims searched: 1 at least

Examiner: Sue Willcox
Date of search: 7 July 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O):

Int Cl (Ed.6):

Other: Onine databases: WPI, Japio

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X, Y	GB 2304252 A	(BURDER) see whole document	X: 1 - 4, 6 - 8, 10,11,13, 14,16,17 Y: 5
Y	GB 2271903 A	(HARROLD) see page 8, line 16 to page 9, line 23	5 at least
X	EP 0597396 A1	(EASTMAN KODAK COMPANY) see abstract	9 at least
X	US 4829339 A	(DWYER) see column 11, lines 35 - 51	9 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.